

A brief critical history of NPV

Roland Fox

Senior Lecturer in Finance

Salford Business School

Salford University.

M5 4WT

UK

A brief critical history of NPV

Abstract

The rationale for using NPV for project evaluation appears weaker than ever. Authoritative texts in attempting to extend NPV by the inclusion of options, strategy and games far from enriching the model present evermore loosely argued rationales that are becoming contradictory. A brief review helps to understand how this state of affairs has arisen and how future analysis might develop.

As an addendum and in part an explanation of the current state of affairs it is interesting to note that this subject has a very limited outlet. As a critique of the attempt in textbooks to present an overall account of project valuation, this paper is seen by educational journals as dealing with content and therefore not educational and by content journals as not extending the boundaries and therefore not contributing. As a result, out of date and decidedly loose accounts of valuation are allowed to survive without comment.

KEYWORDS: Discount Cash Flow, Net Present Value, Real Options, Strategy, Textbooks.

1. Introduction

This paper argues that the ‘grand narrative’ of valuation in finance textbooks is producing a normative structure of growing inconsistency¹. The brief review offered here shows a failing to formally acknowledge the inherent incompleteness of valuation models in favor of presenting a grand theory of valuation. This is despite ample evidence at a theoretical and applied level to the contrary. The argument here lies strictly within the economics based axiomatic structure – it is within this formalism that accounts are becoming confused; behavioral and organizational axioms (Cooper 1975) are part of a separate debate not addressed here. The outcome of the adherence to NPV is that accounting processes are in danger of being seen as increasingly irrelevant to business.

The first part reviews the current state of capital budgeting analysis; the role of NPV is then reviewed in relation to the alternative accounts founded upon financial economics, options and strategy. Finally the possibility of a more inclusive approach is assessed. The long standing critique based on

Fragmented explanations of capital budgeting

Textbooks represent the conduit from academia to practitioners; its statements serve to guide future practice and acts as a reference point. With regard to capital budgeting, the predominant paradigm in undergraduate texts is that of financial economics.

There has for long been considerable equivocation in the treatment of project valuation in textbooks, as a typical example, Bodie and Merton comment with respect to project valuation that “none of the rules are as universally applicable as the NPV rule” (Bodie and Merton, 2000, p. 113) only to end their book with “firms can almost always wait before making their initial outlay... conventional NPV understates the value of the project because it ignores the option’s time value” (Bodie and Merton, 2000, p. 453). Most authoritative texts follow a similar path. A recent text asserts that ‘the concepts of present value and net present value can easily be applied to any investment, such as the construction of a new factory, the launch

of a new product, the takeover of a competing company or any other asset' (Vernimmen et al, 2005, p. 97) only to introduce options later in bold 'the conventional approach to investment decisions ignores a key feature of many investment projects: flexibility' (Vernimmen et al, 2005, p. 373) and then argues that with respect to the real options: 'Their main advantage is that they force users to reason 'outside the box' and come up with new ideas' (Vernimmen et al, 2005, p. 382). In looking at multinational capital budgeting Levi (2009 p. 436 et seq) offers NPV as the only solution with a project example predicting results 10 years ahead despite long standing evidence that firms do not plan more than 3 or 4 years (Scapens et al., 1982; Arnold and Hatzopolous, 2000). Strategy and its more formal counterpart, game theory, generally does not appear in formal accounts of valuation but its significance is outlined by Grenadier as follows: 'A feature that the vast majority of real options articles have in common is the lack of strategic interaction across option holders. Investment (exercise) strategies are formulated in isolation, without regard to the potential impact of other firms' exercise strategies... To understand investment in industries with competitive pressure, a game-theoretic analysis of equilibrium is essential.' (Grenadier, 2002, p. 691). Thus from the highly specific NPV model we learn that its result is almost always wrong and in addition that options do not provide an easy "fix".

For the accountant who is tasked in practice with valuing individual projects, the situation is one of confusion. Indeed the comment by Dickerson shortly before the major theoretical developments in valuation still seems apt today namely: 'When we consider the limitations of the theory of capital budgeting it is not surprising that much of the actual decision making in industry is the result of guesswork and subjective assessment rather than calculation' (Dickerson, 1963, p. 58). A more recent equivalent includes options as part of an informal subjective analysis and suggests suitable projects as "ones that their gut feelings tell them deserve funding despite what the DCF numbers suggest" (van Putten and MacMillan, 2004, p. 141). Surveys confirm that analysis is an ill defined amalgam of financial and non financial techniques (Ryan and Ryan, 2002; Arnold and Hatzopolous, 2000; Abdel-Kader and Dugdale, 1998; Bhimani and Langfield-Smith, 2007). This is often presented as evidence of a gap between theory and practice, yet in looking at the pronouncements of texts one might well argue that it is practice trying to make sense of disparate theories.

The financial economic model

The long list of Nobel prizes and the wide scope of the analysis, from shareholder to investment, and its use of mathematical models offering an attractive precision to the analysis make this analysis the dominant paradigm in texts. Asset pricing is defined as follows: 'Asset pricing theory all stems from one simple concept... price equals expected discounted payoff' (Cochrane, 2001: p. xii). That asset pricing theory applies to projects and firms as projects is stated succinctly by Merton: 'An asset is defined as a production technology which is a probability distribution for cash flow ... Each firm in the model is assumed to invest in a single asset and to issue one class of securities, called equity ... any 'real' firms holding more than one type of asset will be priced as if it held a portfolio of 'firms' ... Hence the term 'firm' and asset can be used interchangeably' (Merton, 1973, p. 870). Clearly the representation is something of an approximation, the argument is that it is nevertheless sufficient for valuation purposes: 'The proponents of the model (CAPM) who agree with the theoretical objections, but who argue that the capital market operates 'as if' these assumptions were satisfied, are themselves not beyond criticism... Nonetheless, the model is still used because it is an equilibrium model which provides a strong specification of the relationship among asset yields that is easily interpreted, and the empirical evidence suggests

that it does explain a significant fraction of the variation in asset returns.’ (brackets added).’ (Merton 1973).

The impressive sweep of the analysis: from personal consumption/ investment decisions to the role of the market as financial intermediation, through to project or firm cost of capital to asset valuation is particularly attractive to the accountant. It provides a stewardship based link between investor or shareholder preferences and project appraisal via separation theorem. Thus the accountant, as auditor, can argue in theory at least that discounting using the CAPM rate maximizes shareholder value. That there are a host of measurement problems (e.g. Haugen, 2001, p. 251) and surveys report that the full CAPM version is generally not carried out in practice and that alternative practical models despite advocacy dating back to the 1960’s remain popular (e.g. Ryan and Ryan, 2001; Arnold and Hatzopolous, 2000) has left the model largely untouched as an account of asset valuation. Cochrane cites the problem as being: ‘Asset pricing theory shares the positive versus normative tension present in the rest of economics. Does it describe the way the world *does* work, or the way the world *should* work.’ (author’s italics 2001, p.xii). It appears that the tension between the normative and the positive is almost non existent, the normative predominates. Thus the view has been for many years that the ‘gap’ between theory and practice would be bridged by practice adopting theory (Arnold and Hatzopolous, 2000).

The financial economic paradigm is really the bringing together of finance and economics - two separate strands. The finance element has a much longer history based as it is on actuarial formulae. The original formulae were published in the 1600’s. Surprisingly, the early sources even included continuous discounting (Lewin, 1981). For centuries these formulae were used for borrowing and lending or in the language of the financial economist to value “financial assets” of near certain cash flows with a single risk of default. The suggestion that the formulae should be the basis of project evaluation is generally credited in the modern era to Dean (1951) who refers to ‘discounting the stream of capital earnings to take account of the diminishing value of distant earnings... discounting has practical importance when there are distinctive time patterns of income streams of different assets and when the discount rate (logically the firm’s cost of capital) is high, for example 15% or 20%’ (Dean, 1951, p. 22). It is described as essentially a practical tool that is occasionally of use. Interestingly, he also refers to the concept of real options when stating ‘Another widely used standard for choosing among investments is postponability... many companies use postponability as a screen to reject projects that can be deferred.’ (Dean, 1951, p. 27). In this writing NPV appears to be supporting a valuation problem that is seen as not being wholly or adequately defined by NPV itself – it did not have a normative role. The apparent gap between present value techniques and practice really began with the view that businessmen were unsophisticated, Christenson (1955) for example published tables his rationale being that: “The past reluctance of businessmen to use the present value concept in allocating capital resources may have had a variety of causes. Many may have been discouraged by the apparent complexity of the mathematics involved. Others no doubt felt that the added refinement of technique was not justified in view of the rough estimates to which the techniques are applied.” (p.666) – the hidden assumption being that present value was an adequate modeling of the problem, an assumption not made by Dean. Stonehill and Nathanson, (1968) make clearer link with the old rationale in their survey of 110 multinationals:

“Most of the corporations which were interviewed indicated that they separated capital requests into various categories similar to those originally described by Joel Dean. Financial

investment criteria were used most often in evaluating relatively small cost-saving projects, replacement projects, and other projects which would fall under the purview of local managers. For relatively large or strategic investments, however, financial investment criteria were used only as a rough screening device to prevent obviously unprofitable projects from wasting the time of the board of directors.”(Stonehill and Nathanson, 1968, p.40). Despite the evidence that more is needed for strategic analysis they later suggest that: “In a general equilibrium model we could rank all projects by their contribution to net present value and all sources of funds, foreign and domestic, by increasing cost to the firm. The decision rule would then be to accept all projects and use all sources of funds until the marginal cost of capital had risen to the point where acceptance of another project would show a negative net present value if its incremental returns were discounted by the marginal cost of capital.” (Stonehill and Nathanson, 1968, p.42), in effect what subsequently became the prevailing orthodoxy. Over the next 40 years, discounting became ever more stridently advocated. For example, Ross et al (1993 p. 159) state that: ‘To summarize, the payback period is not the same as the NPV rule and is therefore conceptually wrong ...After this course you would do your company a disservice if you ever used the payback period instead of the NPV when you had a choice’ little wonder that in an increasingly litigious environment firms seem ever more eager to tick the NPV box (Arnold and Hatzopolous, 2000; van Cauwenbergh et al, 1996). Although originally posed as one practical suggestion amongst others by Dean, the subsequent enthusiasm of Ross et al is explained by its centrality in financial economic theory. In scope it has the feel of a theory of everything as it is applied to all cash flows in whatever context for whatever “asset”.

Successive surveys (Ryan and Ryan, 2002; Arnold and Hatzopolous, 2000) appear to show that practice is indeed changing to the DCF approach. The tone of the articles reflects the dominance of the NPV approach. For instance Arnold and Hatzopolous (2000, p. 622) observe that:

‘The survey results indicate that UK corporations have increasingly adopted prescribed textbook financial analysis...only a small minority do not make use of discounted cash flows... However, managers continue to use simpler rules-of-thumb techniques... The older approaches have numerous endearing qualities which modern techniques seem unable to provide.’

The shortcomings of NPV can be inferred from the persistence of alternative techniques in surveys and also indirectly in surveys of option usage (Busby and Pitts, 1997; Verbeeten, 2006). It seems clear that in practice industry has not changed greatly from the 1968 survey by Stonehill and Nathanson. NPV does not suite higher level decisions, Carr and Tompkins’ (1998) international sample of car component suppliers report that 100% of the US sample used DCF but only 50% used DCF for ‘strategic’ decisions. Similarly, Abdel Kader and Dugdale (1998) list a wide variety of other strategic and market factors that are seen by practitioners as being of equal or more importance than DCF in practice.

There has also been a noticeable dearth of articles that are actual DCF case studies in the same vein as the literature on ABC costing - as an example of another academic based advocated approach (e.g. Cardinaels et al, 2004; Major and Hopper 2005). Recently, Miller and O’Leary (2007, p. 3) noted that: ‘Even today, we know remarkably little about how capital budgeting practices are devised and made operable in particular contexts... it is as if such issues have ‘fallen between the gaps’ that separate the distinct yet related literatures of accounting, finance and strategy’ – a remarkable statement given that it is some 50 years after the Christenson article first noted that businessman seemed reluctant.

The persistence of financial economics as the principal paradigm for financial valuation of projects is something of a mystery. Over 50 years of evidence that it is an insufficient model in practice is apparently not enough to persuade many academics that a revision is needed. Cochrane's answer explains the value of the discount model as follows: "we can also decide that the *world* is wrong, that some assets are "mispriced" and present trading opportunities for the shrewd investor. This latter use of asset pricing theory accounts for much of its popularity and practical application" and with regard to capital budgeting: "We can apply the theory to establish what the prices of these claims *should* be as well; the answers are important guides to public and private decisions" (pxiii). This is little more than academic hubris on an embarrassing scale.

Despite decades of criticism from organizational and behavioral academics (e.g. Scapens, 2006) it is only the more formal options analysis that is acknowledged in authoritative texts as a significant variation to the NPV rationale.

The options approach

Real options analysis has in many ways followed the same route as DCF in that it too is a valuation formula developed in the financial markets that has been applied to investments (Myers, 1976). The now well known critique that DCF does not include contingent decisions (Dixit and Pyndyck, 1994) is illustrated by simple real options in almost all corporate finance texts. Yet curiously it has not led to a rethink of the NPV model itself, but rather it is seen as a development. In their classic paper Brennan and Schwartz (1985) initially in relation to mining and other natural resource projects claim that: 'It is shown that techniques of continuous time arbitrage and stochastic control theory may be used to value such projects but also to determine the optimal policies for developing, managing and abandoning them. The approach may be adapted to a wide variety of contexts outside the natural resource sector where uncertainty about future project revenues is a paramount concern.' (p. 135). Some 20 years and nearly 1,000 papers later and there is still a search for 'killer apps' Triantis (2006, p. 76).

Part of the problem was indirectly identified 10 years earlier by Merton (1998) in his Nobel acceptance paper, addressing the practical application of options he refers to papers looking at 'options within project investment' (p.339) that are mainly non technical. Human judgment in relation to options has a long history, it has to be remembered that the options market survived on the NYSE without the aid of the formula for over 30 years prior to the B-S model (Franklin and Marshall, 1958). Also, as Cochrane bluntly observes "Real options in particular – the option to build a factory in a particular location – are not based on a tradable underlying security, so the logic of options does not apply' (2001, p.325) - the reference being presumably to market logic.

The impact on practice appears slight. Some 12 years after Myers's original paper, the following is reported from a survey of finance officers: 'Most respondents could recall an example of a real option with which they had dealt, and in about half the cases the option had been necessary for the associated investment to be sanctioned. Few firms have procedures to assess real options in advance. Real options may not always be desirable since, in the eyes of at least some respondents, they can reduce organizational commitment to a project. Very few decision-makers seemed to be aware of real option research but, mostly, their intuitions agreed with the qualitative prescriptions of such work.' (Busby and Pitts, 1997, p. 169). More

recently, Triantis (2005) suggests a usage rate among major corporations as low as a possible 10% with concern about the rigor of the analysis. Thus the original notion that options would be a useful tool for practice has over the years not amounted to wide adoption in practice.

It seems doubtful that even a simplified options approach as illustrated in textbooks will ever have practical currency. Even the simplest methodologies - a lattice and risk adjusted probabilities (e.g. Broyles, 2003) have difficulties. The original model illustrated by Magee (1964) shows, if nothing else, the complexities of any lattice approach that attempts to model contingent decisions – subsequent attempts fare little better (e.g. that article in strategic book). The process is always vulnerable to becoming a ‘bushy mess’ (Raiffa, 1967, p 239 et seq.) which has to be simplified to model an actual situation. Given this particular problem with contingent decisions, the failure of papers to use anything other than very simple lattices avoids a known problem in using this technique.

But in many ways the most damaging criticism of options is that for projects in an interactive environment the analysis is conceptually wrong (Grenadier, 2006; Brennan and Trigeorgis, 2000), for that a strategic view is needed.

Valuation and strategy

From the outset of the real options advocacy the wider perspective has been acknowledged. Thus in 1984 Myers observed in his conclusion that: ‘I believe the most promising line of research is to try to use option pricing theory to model the time-series interactions between investments. Both sides could make a conscious effort to reconcile financial and strategic analysis. Although complete reconciliation will rarely be possible, the attempt should uncover hidden assumptions and bring a generally deeper understanding of strategic choices. The gap may remain, but with better analysis on either side of it.’ (Myers, 1984, p.136)

Although the financial literature has attempted to model options *and* strategy, the results are varied with no clear synthesis (e.g. Joaquin and Butler, 2000; Ziegler, 2004; Pawlina and Kort, 2006; Gamba and Micalizzi, 2007). These papers abandon formal modeling making the criteria for any form of synthesis seem unclear and a collection of models may be all that can be hoped for. The negative implications for DCF type modeling when strategy is significant are hard to avoid. Myers attempts a reconciliation as follows: ‘Smart managers apply the following check. They know that all projects have zero PV in long-run competitive equilibrium. Therefore, a positive NPV must be explained by a short-run deviation from equilibrium or by some permanent competitive advantage. If neither explanation applies, the positive NPV is suspect....smart managers do not accept positive (or negative) NPVs unless they can explain them. Strategic planning may serve to implement this check. Strategic analyses look for market opportunities — deviations from equilibrium — and try to identify the firms' competitive advantages. ... No need to calculate the investment's NPV: the manager knows in advance that NPV is positive.’ (Myers, 1984, p. 130) - a view that comes close to negating the value of any formal analysis when strategy is significant. This observation has been translated into textbooks as ‘If you can’t identify the reason a project has a positive projected NPV, then its actual NPV will probably not be positive ... Positive NPV projects don’t just happen – they result from hard work to develop some competitive advantage’ (Brigham and Erhardt, 2005, p. 361). A similar sentiment is expressed by a respondent in a recent survey of practitioners: ‘... before we went ahead and made a deal with a negative NPV ... we would need to be reasonably sure that the NPV, taking into account the softer variables, would end up as positive. We quantify as far as we can: if the financial case doesn’t stand we have to look at the better broader strategic reasons, why we

would do something. In general we are driven by the strategic imperatives. We do quantify things. If the quantification gives us a wrong answer then we look again at the strategy. It is possible that we would not do something that appeared to be strategically desirable if it simply could not be made to work financially, but the main driver is strategic.’ (Bhimani and Langfield-Smith, 2007, p. 17). DCF (or NPV) appears to be serving as little more than a footnote to decisions that are guided by strategy and business decisions.

The strategic literature is of course a separate cognate discipline that does not really share the same perspective as finance or economics. The reaction to the DCF approach seems uniquely hostile, contributors challenge the basic model with an enviable freedom: ‘Effective investment decision taking is the essence of the strategist’s job. The strategic plan should be a guide-line for those decisions as they arise and an aggregation of such decisions. And yet, many so called long-range plans are produced under the aegis of a senior accountant. Many so-called corporate planners report to a finance director. Many so-called strategic plans are really just annual budgets with the handle turned five, or even ten, times instead of just once. Many businesses let their accountant have the final say on strategic investment proposals. But the accountant is, by definition, the wrong man to carry these responsibilities. The very principles on which the accounting profession is based are, and are intended to be, inhibiting to the creative strategist. The accountant’s professional role is to report to the shareholders on how management has discharged its responsibilities for the use of the funds under its control. To do this the profession has evolved certain basic concepts which enjoy universal agreement, if not international application. Such considerations as conservatism and prudence, whilst absolutely essential when reporting on a past period, can be completely stultifying when applied to the future with all its attendant unknowns.’ (Pearson, 1986, p. 18 et seq). A more conciliatory attempt was made by Reimann (1990, p. 64): ‘My basic suggestion is that corporate planners consider abandoning the common practice of adjusting the hurdle rates of individual businesses for differences in risk. ...In the majority of business units, risk differences tend to be quite modest. For these ‘normal’ businesses, the problematic risk adjustment can safely be eliminated. In those instances where the risks of individual businesses or projects are likely to be exceptional, the differences can be reflected (at least approximately) with multiple scenario projections of future cash flows. For special situations like a new, high risk business venture it may be wise not to rely on traditional DCF approaches at all. The important thing to remember is that the careful projection of cash flow patterns will have a far greater impact on accurate valuation than trying to fine tune the hurdle rates to be used in discounting these cash flows.’ Both these views appear to reject even the concept of valuing a project as the basis for decision making. What DCF encapsulates as a stochastic process is the subject of detailed modeling in strategy and regarded as an end in itself (e.g. Huss and Honton, 1987; Blanning and Reinig, 1998; Geurts et al, 2007; O’Brien et al, 2007).

Real options have received a warmer reception in the strategy literature with some attempt to integrate with strategy: ‘The event tree (lattice) framework for structuring real options analysis seems to come closer to the actual needs of managers than do the more sophisticated valuation techniques. ... unlike NPV analysis, the real options perspective assumes managers can intervene in ways that add value over time... Scenario planning and real option analysis focus managers’ attention on very different aspects of investment decision making under uncertainty. ... On the one hand, scenario planning strives to articulate rich, descriptive scenarios that can help managers devise strategies to address uncertainties and exploit opportunities that may not have been recognized by more mechanistic planning models... On the other hand, real option theory has a quantitative orientation... Despite the economic rigor

and feeling of assuredness that is associated with ‘seeing the numbers’, real options valuation can be problematic and imprecise. Our response is to advocate a qualitative approach to evaluating real options and their potential payoffs.’ (Miller and Waller, 2003, p. 99) Thus it is seen as much more manager and decision friendly than DCF and thereby takes little from the DCF formulation.

Another source of strategic considerations is the management accounting literature. Here, strategic management accounting has taken a broader view of the business process using such concepts as value chain analysis, market and competitor analysis, attribute driver analysis and balanced scorecard (Carr and Tomkins, 1996; Roslender and Hart, 2003; Simmonds, 1981, Kaplan and Norton, 1996). Sourced as it is in the management accounting literature there is an emphasis on organizational performance management and control. Whether a similar set of concepts can be broadly adapted to the decision making and strategy formulation required for individual investments is something of an open question but it would once again be a move away from formal modeling.

In sum, the strategic approach to projects shows little communality, has an unclear link to other valuation concepts of options and NPV and even questions the link between strategy and valuation.

Is a grand narrative possible?

The wide advocacy of NPV is based almost entirely on the economic normative model. In this sense NPV can be presented as a kind of “grand narrative” applicable to all projects. By implication the wealth of evidence testifying to the shortcomings of NPV is most often seen as inadequacies of practice. The problem is the assumed irrelevance of context in economic analysis. From the aggregated level of the market or economy the contingent variables of one company, will be offset by another thus washing out the effect. Options is one such set of variables; though significant at individual level, from a market perspective, the ability of one company to switch into a project or delay as opposed to another company starting the project later is not significant. Justification at market level offered by Merton (1973) is not a justification at individual level. Merton makes this clear in saying that it is “as if” the CAPM/NPV assumptions were satisfied from a market perspective but does not address the firm perspective. An analogous argument can be made for marginal cost and marginal revenue curves, here again the analysis is very much “as if” firms could be modeled like this though it is even more difficult to measure and hence is no prescription for practice. The message of options and strategy is not as is presented that the process can be refined but rather that the NPV approximation is not adequate at firm level.

Perhaps the closest to admitting that the overall valuation problem in finance is not a cohesive whole in the financial literature is by Brennan and Trigeorgis who offer the following overview: “It is useful to distinguish three stages in the evolution of the valuation models used in project analysis. We shall refer to models corresponding to these stages as (1) static, or mechanistic models, in which an investment project is completely described by a specified stream of cash flows whose characteristics are given; (2) controllable cash flow models, in which projects can be managed actively in response to the resolution of exogenous uncertainties about output price and other variables; and (3) dynamic, game theoretic models, in which it is assumed that projects can be managed actively to take into account not only the resolution of exogenous uncertainties but also the (re)actions of outside parties, in particular of competitors in the product market.” (2000, p.1). Their reference to stages in the evolution

is later described as a development of financial theory but as a comment on anything more than the literature the analysis is problematic. As noted above, textbooks struggle to make anything more than a casual link between the approaches.

A grand narrative has not arisen in the literature and indeed does not appear to be of any great concern. The essentially analytical approach of academics is content to accommodate comments such as, in relation to options, it : “undermines the theoretical foundation of standard neoclassical investment models” (Pindyck, 1991, p.1110) and still advocate NPV for valuation in practice. Its usefulness as a model at market level apparently outweighs the wealth of evidence as to its inadequacies at firm level.

Concluding discussion

The problem identified here is the persistent advocacy of NPV in spite of its failure to address developments that are essentially within its axiomatic structure – options and strategy. This leads to a form of equivocation in any writing that attempts to address the wider scope – NPV is almost always applicable but is almost always wrong because it does not account for delay, flexibility, irreversibility, competition, strategy, games or the results are not to be trusted unless they can be verified by other means. As the qualifications are ill defined in operational terms, the practitioner may justifiably feel confused in applying finance to project selection decisions using the literature as a guide. Over 50 years of advocacy of NPV with increasing rather than decreasing detractors within its own sphere requires a rethink of when it can and cannot be used. One suspects that the message of surveys in relation to project evaluation is broadly correct- a portfolio of relatively simple financial measures alongside concerns over dynamic risk management and strategy, but not NPV.

References

Abdel-Kader, M.G. and Dugdale, D. (1998). ‘Investment in advanced manufacturing technology: a study of practice in large U.K. companies’. *Management Accounting Research*, 9 (3): 261 -284.

Arnold, G and Hatzopoulous, P. D. (2000). ‘The Theory Practice Gap in Capital Budgeting: evidence from the UK’. *Journal of Business Finance and Accounting*, 27, (5) & (6): 603 – 626.

Bhimani, A. and Langfield-Smith K. (2007). ‘Structure, formality and the importance of financial and non-financial information in strategy development and implementation’. *Management Accounting Research*, 18 (1): pp. 3–31.

Bhimani,A., Ncube,M. and Soonawalla, K. (2006). ‘Intuition and Real Real options-Based Investment Appraisal: A Cross-National Study of Financial Executives’. *Journal of Applied Management Accounting Research*, 4 (2): 11- 33.

Blanning, R.W. and Reinig, B.A. (1998). ‘Building Scenarios for Hong Kong Using EMS’. *Long Range Planning*, 31 (6): 900 – 910.

Bodie, Z., and Merton, R.C. (2000). *Finance*, Prentice Hall.

- Brigham, E.F. and Ehrhardt, M.C. (2005). '*Financial Management: Theory and Practice*'. 11th ed, Thomson
- Brennan, M.J. and Schwartz, E.S. (1985). 'Evaluating Natural Resource Investments', *Journal of Business*. 58 (2): 135 – 157.
- Brennan, M.J. and Trigeorgis, L. (2000). 'Real options, developments and New Contributions', 1 – 10, in '*Project Flexibility, Agency and Competition*', Brennan, M.J. and Trigeorgis, L. (eds) OUP
- Broyles, J. (2003), *Financial Management and Real options*, Wiley
- Busby J. S. and Pitts C. G. C. (1997). 'Real options in practice: an exploratory survey of how finance officers deal with flexibility in capital appraisal' *Management Accounting Research*, 8 (2): 169 – 186.
- Cardinaels, E, Roodhofs, F. and Warlop, L. (2004). 'The Value of Activity – Based Costing in Competitive Pricing Decisions'. *Journal of Management Accounting Research*, 16: 133 – 148.
- Carr, C and Tomkins, C (1998). 'Context, culture and the role of the finance function in strategic decisions, a comparative analysis of Britain, Germany, the U.S.A. and Japan'. *Management Accounting Research* 9 (2): 213-239.
- Christenson, C. (1955). Construction of present value tables for use in evaluating capital investment opportunities'. *The Accounting Review*, 30 (4): 666 – 673.
- Cochrane, J.H. (2001). *Asset Pricing*. Princeton.
- Cooper, D.J. (1975). 'Rationality and Investment Appraisal'. *Accounting and Business Research*, (Summer): 198 – 202.
- Dean, Joel (1951). *Capital Budgeting*, New York: Columbia University Press, 1951
- Dickerson, P.J. (1965). 'Capital Budgeting Theory and Practice'. *California Management Review*, Fall: 53 – 60.
- Dixit A.K. and Pyndyck, R.S. (1994) *Investment under Uncertainty*, Princeton University Press
- Franklin, C.B. and Marshall, C.R. (1958). 'Puts and Calls: A Factual Survey'. *Journal of Finance*, 13 (1), 21 – 34.
- Gamba, A. and Micalizzi, A. (2007). 'Product Development and Market Expansion: A Real options Model'. *Financial Management*, 36 (1): 91-112.
- Geurts, Jac L., Duke, Richard D. A., Vermeulen Patrick A. M. (2007). 'Policy Gaming for Strategy and Change'. *Long Range Planning*, 40 (6): 535-558.

- Goldstein, R. (2005) *Incompleteness: the proof and paradox of Kurt Godel*, W. W. Norton & Co.
- Grenadier, S.R. (2002). 'Option Exercise Games: An Application to the Equilibrium Investment Strategies of Firms'. *The Review of Financial Studies*, 15 (3): 691-721.
- Haugen, R.A. (2001)., *Modern Investment Theory*, Prentice Hall.
- Huss, W.R. and Honton, E.J. (1987). 'Scenario Planning – What Style Should You Use'. *Long Range Planning*, 20 (4): 21 – 29.
- Joaquin, D.C. and Butler, K. C. (2000). Competitive Investment Decisions: A synthesis, 324 – 339. in 'Project Flexibility, Agency and Competition', Brennan, M.J. and Trigeorgis, L. (eds) OUP
- Kaplan, R.S. and Norton, D.P. (2001). *The strategy –Focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment*, Boston, MA:Harvard Business School Press.
- Levi, M. (2009). 'Multinational Finance', Routledge.
- Lewin, C.G. (1981). 'Compound interest in the 17th Century'. *Journal of the Institute of Actuaries*, 108: 423-442.
- Lyotard, J-F. (1979). 'The Postmodern Condition: A Report on Knowledge', MUP.
- Magee, J. F. (1964). 'Decision Trees and Decision Making'. *Harvard Business Review*, 42 (4), July/August: 126 – 138.
- Major, M, Hopper, T. (2005). 'Managers divided: Implementing ABC in a Portuguese telecommunications company'. *Management Accounting Research*, 16 (2): 205 – 229.
- Merton, R.C. (1973). 'An Intertemporal Capital Asset Pricing Model'. *Econometrica*, 41 (5): 867 – 887.
- Merton, R. C. (1998). 'Applications of Option-Pricing Theory: Twenty-Five Years Later', *The American Economic Review*, 323 – 349.
- Miller, P. and O'Leary, Ted (2007). 'Mediating instruments and making markets: Capital budgeting, science and the economy'. *Accounting Organizations and Society*, 32 (7,8): 701-734.
- Miller, Kent D., Waller, Gregory, H. (2003). 'Scenarios, Real options and Integrated Risk Management'. *Long Range Planning*, 36 (1): 93 – 107.
- Myers, S.C. (1976). 'Determinants of Corporate Borrowing', *Working Paper* 875 – 76, Sloan School of Management, M.I.T.
- Myers, S.C. (1984). Finance Theory and Financial Strategy, *INTERFACES*, 14 (1), January-February: 126-137.

- Nawrocki, D. N. (1996) 'Apocalypse Revisited: Do You Know Where Your Optimizer Is at Night', *Journal of Financial Planning*, Vol. 9 Issue 6, p68-75
- Pawlina, G. and Kort, Peter M. (2006). Real Options in an Asymmetric Duopoly: Who Benefits from Your Competitive Disadvantage? *Journal of Economics & Management Strategy*. 15 (1): 1-35.
- O'Brien, F., Meadows, M. and Murtland, M. (2007). 'Creating and Using Scenarios – Exploring Alternative Possible Futures and their Impact on Strategic Decisions'. In *Supporting Strategy*, O'Brien, Dyson, R. (eds) Wiley: 211-247.
- Pearson, G. (1986). 'The Strategic Discount Protecting New Business Projects Against DCF' *Long Range Planning*, 19 (1): 18-24.
- Pindyck, Robert S. (1991). Irreversibility, Uncertainty, and Investment *Journal of Economic Literature*, 29 (3): 1110-1148.
- Raiffa, H. (1967). *Decision Analysis: Introductory Lectures on Choices under Uncertainty*, Addison-Wesley.
- Reimann Bernard C. (1990). Why Bother with Risk Adjusted Hurdle Rates?, *Long Range Planning*, 23 (3): 57- 65.
- Roslender R., Hart S. J. (2003). 'In search of strategic management accounting: theoretical and field study perspectives', *Management Accounting Research*, 14 (3): 255–279.
- Ross, S.A. Westerfield, R.W. and Jaffe, J.F. (1993). *Corporate Finance*, 3rd edn., Irwin.
- Ryan, P.A., Ryan, G.P. (2002). 'Capital budgeting practices of the Fortune 1000: how have things changed?', *Journal of Business and Management*, 8 (4): 355-64.
- Scapens, R. W. (2006) Understanding management accounting practices: A personal journey, *British Accounting Review*, 38, pp 1–30.
- Scapens, R.W., Sale, J.T. and Tikkas P.A. (1982) Financial Control of Divisionalised Capital Investment (The Institute of Cost and Management Accountants)
- Simmonds , K. (1981). 'Strategic management accounting', *Management Accounting* , 59 (4): 26 – 29 .
- Stonehill Arthur, and Nathanson, L. (1968). Capital Budgeting and the Multinational Corporation, *California Management Review*, 10 (4): 39 – 54.
- Thomson, W. (2001) 'On the axiomatic method and its recent application to game theory and resource allocation', *Social Choice and Welfare*, 18, pp327 – 386.

Tomkins, C. and Carr, C. (1996). 'Reflections on the papers in this issue and a commentary on the state of Strategic Management Accounting', *Management Accounting Research*, 7 (2): 271 – 280.

Triantis, A. (2006) 'Realizing the Potential of Real Options: Does Theory Meet Practice? In Financial Strategy, 2nd edⁿ, Rutterford, J., Upton, M. and Kodwani, D. (eds), Wiley.

Van Cauwenbergh, A. Durinck, E. Martens, R. Laveren, E. and I. Bogaert (1996). 'On the role and function of formal analysis in strategic investment decision processes: results from an empirical study in Belgium' *Management Accounting Research*, 7 (2): 169-184.

van Putten Alexander B. and MacMillan Ian C. (2004). Making Real options Really Work, *Harvard Business Review*, December: 134 – 141.

Verbeeten, F.H.M. (2006). Do Organizations adopt sophisticated capital budgeting practices to deal with uncertainty in the investment decision? A research note, *Management Accounting Review*, 17 (1): 106 – 120.

Vernimmen, P., Quiry, P., Dallochio, M., Le Fur, Y. And Salvsi, A. (2005). *Corporate Finance: Theory and Practice*, Wiley.

Ziegler, A. (2004). *A Game Theory of Analysis of Options: Corporate Finance and Financial Intermediation in Continuous Time*. Springer Finance

¹ The reference is to Lyotard (1979), both Lyotard and Godel (the later reference) in their own very different spheres argue against the concept of a dominant framework/culture.